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(54) **HOLLOW MOLDED MATERIAL AND ITS MOLDING METHOD**
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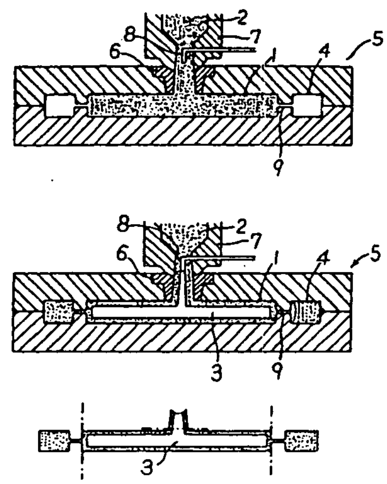

PURPOSE: To make the state of a surface good and save the work such as finish processing by filling molten synthetic resin in a cavity, and then force fitting hollow section-forming fluid into said cavity and extruding the molten synthetic resin in the cavity into an auxiliary chamber to form a hollow section.

CONSTITUTION: An injection nozzle 7 is brought into contact with a sprue 6 of a closed mold 5 and molten synthetic resin is filled in a cavity 1. Hollow section forming liquid is force fitted into the cavity 1 after the molten synthetic resin 2 is filled in the cavity 1 and a hollow section 3 is formed while the molten synthetic resin 2 in the cavity 1 is extruded into an auxiliary chamber 4. At that time, the communication between the cavity 1 and the auxiliary chamber 4 is set to be on and off, and it is preferable to shut off the communication between the two when the molten synthetic resin is injected into the cavity 1, and to open the communication between the two when hollow section forming fluid is force fitted into the cavity 1.

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㊿発明の名称　中空型物及びその成形方法

㉑特　願　平1－258690

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明　細　書

1．発明の名称

中空型物及びその成形方法

2．特許請求の範囲

1）キャビティ内への連続した溶融合成樹脂の注入によって形成されかつ引き伸ばし及び折り畳みを受けていない表面を有し、溶融樹脂の熱収縮量を越える容積率の中空部を有することを特徴とする中空型物。

2）非結晶性樹脂製で、中空部の容積率が10％を越えることを特徴とする請求項第1項記載の中空型物。

3）結晶性樹脂製で、中空部の容積率が15％を越えることを特徴とする請求項第1項記載の中空型物。

4）キャビティ内を溶融合成樹脂で満たしてからこのキャビティ内に中空部形成流体を圧入することによって、キャビティ内の溶融合成樹脂を、キャビティに連通された補助室に押し出しつつ中空部を形成する工程を有することを特徴とする中空型物の成形方法。

5）キャビティ内への溶融合成樹脂の射出時にはキャビティと補助室間を遮断し、キャビティ内への中空部形成流体の圧入時にはキャビティと補助室間を開放することを特徴とする請求項第4項記載の中空型物の成形方法。

6）キャビティ内への溶融合成樹脂注入位置付近から補助室付近へ延び、かつ得られる型物の厚さの0．7倍を越える幅の補強リブを成形するための溝部を有するキャビティを用いることを特徴とする請求項第4項記載の中空型物の成形方法。

3．発明の詳細な説明

［産業上の利用分野］

本発明は、必要な位置に中空部が形成され、中空部の容積が大きくかつ表面状態が良好な中空型物及びその成形方法に関する。

［従来の技術］

従来、キャビティ内に、キャビティ内を満たす量より少ない量の溶融合成樹脂を注入した後加圧

ガスを圧入したり、溶融合成樹脂と共に加圧ガスを圧入することによって中空型物を成形することが知られている（特公昭57-14968号）。

また、上記公報には、加圧ガスの圧入時にキャビティを拡大することによって、より表層の薄い中空型物を成形できることも記載されている。

［発明が解決しようとする課題］

しかしながら、上記従来の中空型物及びその成形方法には次のような課題が残されている。

(1) キャビティ内に、キャビティを満たすに足りない量の溶融合成樹脂を射出した後加圧ガスを圧入したのでは、得られる中空型物の表面に微細な凹凸の環状帯（以下「ヘジテーションマーク」という）が発生する。

(2) また、キャビティ内を溶融合成樹脂で満たしてからキャビティ内にガス圧をかけ、溶融合成樹脂の冷却固化に伴なう熱収縮量に相当する分だけの加圧ガス注入による中空部を形成すればヘジテーションマークは生じないが、熱収縮量に相当する中空部が形成されるに過ぎない。これによって得られる中空部の容積率は、使用する合成樹脂の種類（非結晶性樹脂と結晶性樹脂、非強化樹脂と充填材による強化樹脂）、成形時の温度条件、成形品の厚さ及び形状等によって変わるが、非結晶性樹脂では３～１０％、結晶性樹脂でも６～１５％程度で、１５％を越える大きな容積率の中空部を形成することはできない。

(3) 更に、加圧ガスの圧入位置から離れるに従って、加圧ガスが溶融合成樹脂を押し広げにくくなるので、形成される中空部の厚みが、末端に行くに従って小さくなり、設計通りの中空部が得にくい。

(4) 溶融合成樹脂の射出と共に加圧ガスを圧入することは、通常500kg/cm^2 以上の圧力で射出される溶融合成樹脂の射出圧に抗して加圧ガスを圧入しなければならず、このような高圧ガスを用意する設備上の負担がはなはだ大きくなるので、行われていないのが現状である。

(5) 加圧ガスの圧入時にキャビティを拡大した場合、比較的均一で大きな容積率の中空部を形成できる利点はあるものの、やはり得られる中空型物の表面の一部に欠陥を生じやすい問題がある。

［課題を解決するための手段］

本発明者の知見によると、ヘジテーションマークの発生原因は、溶融合成樹脂の射出から加圧ガスの圧入に切り替える際に、キャビティ内への溶融合成樹脂の注入が断続化されることにある。即ち、キャビティ内に射出された溶融合成樹脂は、キャビティ内壁と接触して直ちに冷却固化を始めるが、上記のように溶融合成樹脂の注入が断続化されると、溶融合成樹脂とキャビティ内壁との接触も断続化されて、ヘジテーションマークの発生原因となるものでである。

一方、加圧ガスの圧入と共にキャビティを拡大する場合は、このキャビティの拡大に伴なって、一旦キャビティ内壁と接触して冷却固化を開始した溶融合成樹脂の表面部が引き伸ばされたり、折り畳まれてしまうことを生じ、これが表面欠陥の原因となる。

本発明は、上記本発明者の知見に基づいて完成されたもので、本発明を第１図で説明すると、請求項第１項の発明では、キャビティ１内への連続した溶融合成樹脂２の注入によって形成されかつ引き伸ばし及び折り畳みを受けていない表面を有し、溶融合成樹脂の熱収縮量をを越える容積率の中空部３を有する中空型物とするという手段を講じているものである。

また、請求項第４項の発明においては、キャビティ１内を溶融合成樹脂２で満たしてからこのキャビティ１内に中空部形成流体を圧入することによって、キャビティ内１の溶融合成樹脂２を、キャビテイ１に連通された補助室４に押し出しつつ中空部３を形成する工程を有する中空型物の成形方法とするという手段を講じているものである。

以下、本発明を更に説明する。

本発明の中空型物において、連続した溶融合成樹脂の注入とは、溶融合成樹脂が、途切れることなくほぼ一定の速度で全キャビティ１内壁に接触

される注入をいう。

本発明の中空型物における引き伸ばしとは、例えば、当初第2図(a)の形状のキャビティ1を拡大して同(b)の形状とした場合に、(a)におけるA部分の溶融合成樹脂2(冷えたキャビティ1の内壁に接して固化が進んだ表層)が(b)におけるA′部分のものとして引き伸ばされてしまうように、キャビティ1の拡大によって生ずるキャビティ1内溶融合成樹脂2表面部の引き伸ばしをいう。また、折り畳みとは、例えば、当初第3図(a)の形状のキャビティ1を拡大して同(b)の形状とした場合に、(a)におけるA部分の溶融合成樹脂2(冷えたキャビティ1の内壁に接して固化が進んだ表層)が余って(b)におけるA′として折り畳まれてしまうように、キャビティ1の拡大によって生ずるキャビティ1内溶融合成樹脂2表面部の折り畳みをいう。

中空部3の容積率とは、中空部3を含む中空型物の全体積において中空部3の容積が占める割合をいう。

溶融合成樹脂の熱収縮量を越える具体的容積率は、非結晶性樹脂については10%を越える容積率であり、結晶性樹脂については15%を越える容積率である。

次に本発明の成形方法を説明する。

本発明の成形方法においては、まず、第1図(a)に示されるように、閉鎖した金型5のスプルー6に射出ノズル7を圧接し、溶融合成樹脂を射出して、キャビティ1内を溶融合成樹脂で満たす。

溶融合成樹脂2としては、射出成形できる熱可塑性樹脂、熱可塑性エラストマー、熱硬化性樹脂、これらと従来公知の添加剤やフィラーとの配合物のいずれでもよいが、熱可塑性樹脂、熱可塑性エラストマー及びこれらと従来公知の添加剤、安定剤、フィラー、ガラス繊維等の強化材との配合物が好ましい。

上記溶融合成樹脂2の射出条件は一般の射出成形の場合と同様である。この溶融合成樹脂2の射出は、単一樹脂(非発泡性又は発泡性)の射出、

あるいは従来サンドイッチ成形法として公知の多成分樹脂(非発泡性のみ、発泡性のみ又は非発泡性と発泡性あるいは同種、異種樹脂の組み合わせ)の複合射出のいずれでもよい。

発泡性樹脂を射出する場合、公知の方法でキャビティ1内を加圧しておき、射出充塡中は発泡しないように押えるようにすればよい。

キャビティ1内を溶融合成樹脂2で満たした後、第1図(b)に示されるように、中空部形成流体をキャビティ1内に圧入し、キャビティ1内の溶融合成樹脂2を補助室4内に押し出しつつ中空部3を形成する。

中空部形成流体の圧入は、第1図(b)に示されるように、射出ノズル7に内蔵された流体ノズル8によって行うと容易に行うことができる。また、この中空部形成流体の圧入は、上記射出ノズル7から行う他、湯道に対して行ったり、キャビティ1内に直接行ってもよい。

中空部形成流体としては、例えば窒素、炭酸ガス、空気等のように、無害で成形温度及び射出圧力下で液化しないガスが一般的であるが、溶融合成樹脂と相溶性のない液体やオリゴマーを用いることもできる。

補助室4は、上記中空部形成流体の圧入によって押されたキャビティ1内の溶融合成樹脂が流入できるよう、キャビティ1と連通されている。このキャビティ1と補助室4間の連通は、前記溶融合成樹脂2でキャビティ1内を満たす際に、キャビティ1内に先立って補助室4内も溶融合成樹脂2で満たされてしまわないよう、溶融合成樹脂2の流動抵抗が大きくなるよう調整された連絡通路9を介して行われていることが好ましい。

上記のように溶融合成樹脂の流動抵抗を大きくしておく観点から、連絡通路9は、キャビティ1の厚さの1～1/20程度の厚さ、具体的には、通常1.5～10㎜、最適には3～5㎜程度であることが好ましい。また、連絡通路の断面が円形の場合は、キャビティ1の厚さの1～1/20程度の直径に設定することが好ましい。連絡通路9の厚さや径が大き過ぎると、初めに行うキャビ

ティ1のみへの優先的溶融合成樹脂2の充満を達成しにくくする。逆に、連絡通路9の厚さや径が小さ過ぎると、その後に行う中空部形成流体の圧入による溶融合成樹脂2の補助室4への移動がしにくくなる。

キャビティ1と補助室4間の連通は、開閉可能とし、キャビティ1内に溶融合成樹脂を射出する時に両者間の連通を遮断し、キャビティ1内に中空部形成流体を圧入する時に両者間の連通を開放することが好ましい。この場合、連絡通路9の厚さを上記範囲より大きくすることも可能である。

補助室4は、連絡通路9より大きな厚みを有し、形成すべき中空部3の体積にほぼ見合う体積、あるいは中空部3の体積から溶融合成樹脂2の熱収縮量を減じた体積に形成されたもので、単数であっても、複数であってもよい。複数の場合、合計した体積が形成すべき中空部3の体積にほぼ見合うものであればよい。通常、この補助室4の大きさは、キャビティ1の厚さが1.5～8mm程度の場合、全型容積（キャビティ1と補助室4の合計容積）の2～20%程度、キャビティ1の厚さが8mmを越える場合、全型容積の10～50%程度であることが好ましい。

補助室4の断面形状は、円形、半円形、三角形、台形、矩形、楕円形及びこれらの形状の組合わせのいずれでも良い。特に、補助室4の断面形状を円形にすると、中空部形成流体がキャビティ1内及び補助室4内の溶融樹脂の流動先端より先に流出してしまうのを抑止する効果が得られるので好ましい。

中空部3は、中空部形成流体の圧入時に、キャビティ1内の溶融合成樹脂が流れる方向に形成されるので、キャビティ1のどこに補助室4を連通させるかによって、中空部3の形成位置及び形状を調整することができる。

例えば、第4図（a）に示されるように、中心部から溶融合成樹脂2及び中空部形成流体が注入される円形のキャビティ1の側部に1つの補助室4を連通させた場合、図示されるように、中心部

から補助室4に向かう偏心した中空部4が形成される。また、第4図（b）に示されるように、（a）と同様なキャビティ1の周囲等間隔に3つの補助室4を連通させた場合、図示されるように、中心から三方に向う中空部4が形成される。更に、第4図（c）に示されるように、キャビティ1内の所望の位置に溝部10を形成し、当該箇所のキャビティ1内空間を広げておくと、この溝部10に沿って中空部3を形成することができる。この溝部10は、キャビティ1内への溶融合成樹脂2注入位置から補助室4方向に延在させておくことが好ましい。

特に、上記第4図（c）の方法を利用することによって、従来困難であった広幅の補強リブを有する型物を成形することが可能となる。

即ち、第4図（c）に示される溝部10を補強リブ形成のための溝とすると、型物の厚さの0.7倍を越える幅の補強リブを設けても、補強リブ裏面に、一般の射出成形では防止することができない熱収縮によるヒケを発生させることなく、当該補強リブを形成することができるのである。これは、溝部10に沿って中空部形成流体が流れ、補強リブ内に中空部3が形成されるためである。

上記補強リブの幅は、得られる型物の厚さの3倍、更には4倍を越える幅であることが好ましい。この幅を広くとると、より強固な補強が可能になるだけでなく、より低い圧力で中空部形成流体を溝部10に注入することができるようになる。

上記のようにして中空部4を形成した後は、中空部形成流体の圧力を維持したままキャビティ1内の溶融合成樹脂2を冷却固化させ、その後中空部4内の中空部形成流体を排出してから金型5を開いて中空型物を取り出せばよい。中空型物は、補助室4に流入して固化した樹脂が付いた第1図（c）の状態で取り出されるが、この余剰部は、図中一点鎖線で示される位置で切り離せばよい。

尚、補助室4を中実型物のキャビティとし、中

空部成形流体の圧入時に、中空型物成形用のキャビティ1から押し出される溶融合成樹脂でこれが満たされるようにすれば、中空型物と共に、忠実型物をも成形することができる。しかし、本発明においては、補助室4はキャビティである必要はなく、成形時に溶融合成樹脂で満たされない大きさのものや、成形品に応じた形状ではないものでよい。

［作　用］

請求項第1項の発明において、表面が、キャビティ1内への連続した溶融合成樹脂の注入によって形成されていることは、溶融合成樹脂とキャビティ1内壁の接触が断続化されることによるヘジテーションマークの発生を防止する働きをなす。また、引き伸ばし及び折り畳みを受けていないことにより、これらによる表面欠陥が防止されるものである。そして、この表面欠陥の防止は、請求項第2項及び第3項に示されるような容積率の中空部3を有する中空型物についてももたらされるものである。

請求項第4項の発明において、まずキャビティ1内を溶融合成樹脂2で満たしているのは、溶融合成樹脂2を連続してキャビティ1内壁面に接触させることにより、ヘジテーションマークの発生を防止する働きをなす。また、中空部形成流体の圧入により溶融合成樹脂2を補助室4に押し出すのは、中空部3に相当する量の余剰溶融合成樹脂2をキャビティ1外へ出して、中空部形成流体をキャビティ1内へ導き入れ、中空部3の形成を可能にする働きをなす。

更に請求項第5項の発明のようにキャビティ1と補助室4間の連通を開閉すると、連絡通路9の厚さを大きくしても、キャビティ1内のみへ溶融合成樹脂を優先的に充満させることができ、また連絡通路9の厚さを大きくすることで、中空部形成流体圧入時の溶融合成樹脂の補助室4への流入をスムーズにすることができる。

また、請求項第6項の発明における溝部10は、中空部形成流体を案内し、補強リブ内に中空部を形成させる働きをなす。

［実施例］

実施例1

キャビティ1の両側に各々連絡通路9を介して補助室4が連結された容積3ccのダイレクト・スプルー方式の金型5を用いて中空型物の成形を行なった。キャビティ1の大きさは、幅5cm、長さ40cm、厚さ0．4cm、両側の補助室4の大きさは、各々幅5cm、長さ5cm、厚さ0．4cm、連絡通路9の大きさは、各々幅3cm、長さ1cm、厚さ0．4cmとした。

合成樹脂としては、ゴム強化ポリスチレン（旭化成工業株式会社製「スタイロン　494」）を用い、下記の条件で射出してキャビティ1を満たした。

射出シリンダー温度	220℃
射出圧力	500kg/cm²G
計量値	90cc
射出充填時間	4秒
金型温度	50℃

上記溶融合成樹脂の射出後、窒素ガスを中空部

形成流体として、下記の条件でキャビティ1に注入し、保持時間満了後、窒素ガスを回収してから金型5を開いて中空型物を取出した。

蓄圧タンク（1ℓ）	120kg/cm²G
平衡圧	109kg/cm²G
保持時間	90秒

樹脂は補助室4まで満たされており、補助室4内で固化した樹脂の表面にはヘジテーションマークが生じていたが、キャビティ1内の成形品には、ヒケやヘジテーションマークがなく、外装品に使用できる水準の表面状態であった。

キャビティ1内の成形品は中空型物となっており、その中空部3の容積率は23％であった。

比較例1

金型5の連絡通路9を閉鎖し、計量値を84ccにした以外は実施例1と同じ装置、樹脂及び条件で成形を行った。

得られた成形品は、ヘジテーションマークのない表面を有していたが、流動末端部にはヒケが発生した。成形品の中空部3は、スプルー6の周囲

に局部的に形成され、末端部には中空部3は形成されておらず、中空部3の容積率は約4％であった。

窒素ガスの保持時間を90秒から180秒に延長したところ、ヒケは少し減少したが、やはり良好な外観とはいえず、また成形品を取り出した後1時間放置したところ、ヒケがやや増加した。

実施例2

中心部に長さ36cm、半径0．3cmの半円断面の溝部10を加工したキャビティ1の両端に、各々連絡通路9を介して補助室4が連結されたダイレクト・スプルー方式の金型5を用いて、第5図に示されるような中空型物の成形を行なった。キャビティ1の大きさは、幅5cm、長さ40cm、厚さ0．3cm、補助室4の大きさは、各々長さ4cm、幅0．9cm、厚さ1cm、連絡通路9の大きさは、各々幅3cm、長さ0．7cm、厚さ0．25cmとした。

合成樹脂としては、コポリマータイプポリプロピレン（旭化成工業株式会社製「M8619

MI14」）を用い、下記の条件で射出してキャビティ1を満たした。

射出シリンダー温度	220℃
射出圧力	600kg/cm²G
計量値	70cc
射出充　時間	3秒
金型温度	40℃

上記溶融合成樹脂の射出後、窒素ガスを中空部形成流体として、下記の条件でキャビティ1に注入し、保持時間満了後、窒素ガスを回収してから金型5を開いて中空型物を取出した。

蓄圧タンク（1ℓ）	140kg/cm²G
平衡圧	132kg/cm²G
保持時間	40秒

樹脂は補助室4まで満たされており、補助室4内で固化した樹脂の表面にはヘジテーションマークが生じていたが、キャビティ1内の成形品には、ヒケやソリがなくヘジテーションマークもない良好な外観であった。

キャビティ1内の成形品は、半径0．3cmの半

円断面のリブの中心が末端まで中空の中空型物となっており、その中空部3の容積率は約19％であった。

比較例2

金型5の連絡通路9を閉鎖した以外は実施例2と同じ装置、樹脂及び条件で成形を行った。

得られた成形品は、ヘジテーションマークのない表面を有していたが、流動末端部のリブ裏面にはヒケが発生した。中空部3の容積率は7％で、中空部3は、中央のスプルー6から約13cmまで半円断面のリブに沿って形成されていたが、中央部から13～20cm（流動末端）の部分には中空部3は形成されていなかった。

窒素ガスの保持時間を80秒に増加すると、中空部3が、中央のスプルー6から約15cmまで伸びたが、流動末端のヒケがわずかに減った程度で、中空部3の形状は第6図のように補強リブ部からはみ出し、鋭角部が形成された。

実施例3

中心部に幅と高さが等しい溝部10を形成し

た、幅20cm、長さ50cmのキャビティ1の両端に、各々幅5cm、長さ0．7cm、厚さ0．25cmの連絡通路9を介して、幅10cm、厚さ1cmの補助室4を連結した金型5を用い、キャビティ1の厚さ及び溝部10の幅（高さ）を変え、それに合わせて補助室4の長さを変えて各々成形を行った。

合成樹脂としては、PPE／PAアロイ（旭化成工業株式会社製「X9601」）を用い、下記の条件で射出してキャビティ1を満たした。

射出シリンダー温度	280℃
射出圧力	1800kg/cm²G
射出充　時間	10秒
金型温度	60℃

必要な射出圧と、溝部10の幅（W）の成形品の厚さ（t）に対する比との関係を第7図に示す。

成形品の厚さ（t）に対する補強リブの幅（W）の比が、3以上、好ましくは4以上で、充に必要な射出圧力が急激に低下することを示

し、両端部の連結通路9、補助室4を設けたことにより、補強リブには末端まで中空部が形成された。

[発明の効果]

本発明は、以上説明した通りのものであり、次の効果を奏するものである。

(1) 請求項第1項及び第4項の発明によれば、表面状態が良好な中空型物が得られるので、仕上加工等の手間を省くことができ、外観を重視する成形品を容易に得ることができる。

(2) 請求項第2項及び第3項の発明によれば、大きな中空部3を有し、しかも表面状態の良好な中空型物とすることができる。

(3) 請求項第4項の発明によれば、中空部形成流体によって押し出された溶融合成樹脂の量に相応して中空部3が形成されるので、中空部3はほぼ一定の厚みで形成される。従って、設計通りの中空部3が得やすい。

(4) 請求項第5項の発明によれば、溶融合成樹脂の射出から中空部形成流体の圧入への切り替え

時期が制御しやすくなる。

(5) 請求項第6項の発明によれば、幅広の補強リブで確実な補強を行うことが、ヒケによる外観低下を生じることなく行うことができる。また、不必要な範囲にまで中空部3を形成せず、必要な範囲に確実に中空部3を形成できるので、余剰の中空部3が形成されることによる成形品の構造強度の欠陥発生を防止できる。

4．図面の簡単な説明

第1図（a）～（c）は各々本発明による中空型物の成形手順の説明図、第2図（a）及び（b）は各々表面の引き伸ばしの説明図、第3図（a）及び（b）は各々表面折り畳みの説明図、第4図（a）～（c）は各々形成される中空部の位置及び形状の説明図、第5図は実施例2で成形した中空型物の斜視図、第6図は比較例2で成形した中空型物の断面図、第7図は実施例3の結果を示すグラフである。

1：キャビティ
2：溶融合成樹脂

3：中空部
4：補助室

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出願人　アァルピィ東プラ株式会社
代理人　豊　田　善　雄
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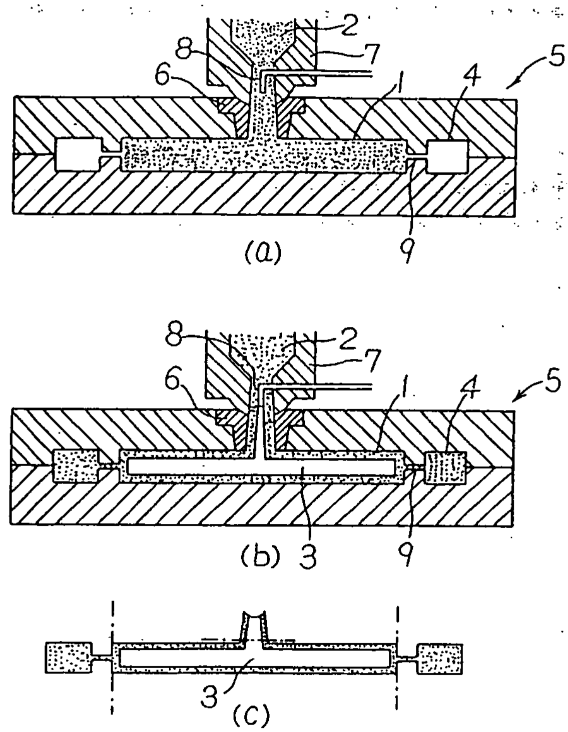
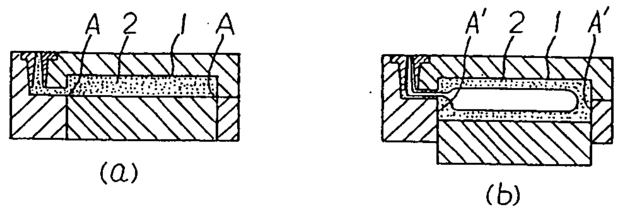
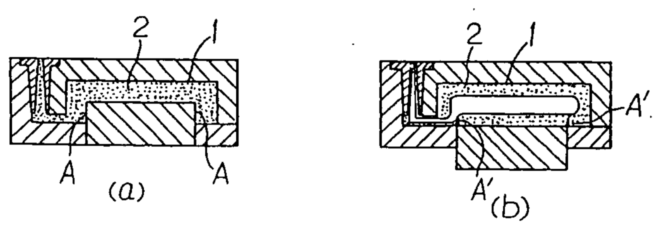


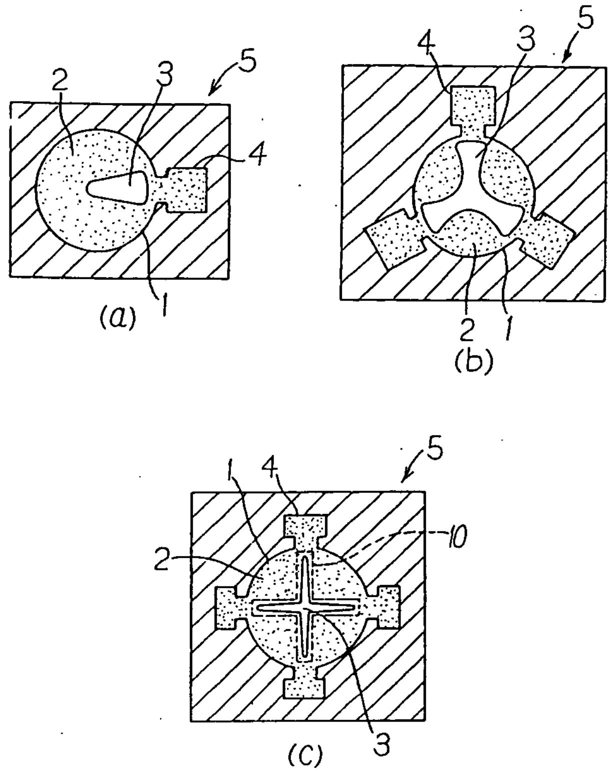
第1図



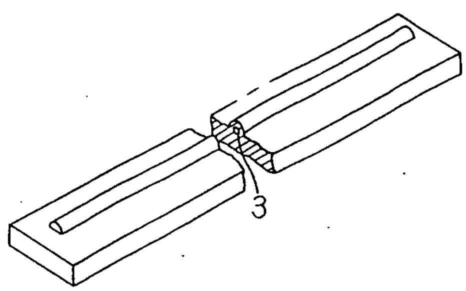
第2図



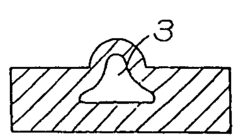
第3図



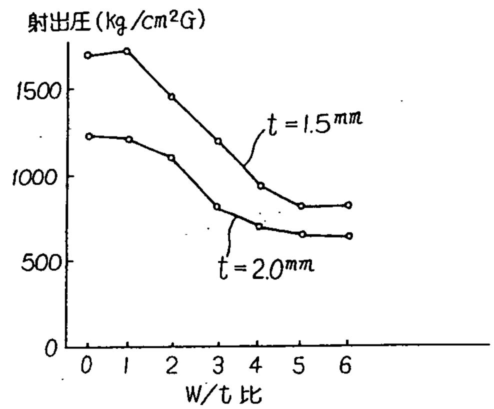
第4図



第5図



第6図



第7図

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Specification

1. Title of the Invention

Hollow Molded Object and Molding Method Therefor

2. Claims

(1) A hollow molded object, wherein the hollow molded object is formed by continuously injecting a melted synthetic resin into a mold cavity, wherein the hollow molded object has a surface that is not overstretched or overlapping, and wherein the hollow molded object has a hollow section with a volumetric capacity exceeding the amount of thermal contraction in the melted resin.

(2) The hollow molded object described in claim 1, wherein the hollow molded object is made of an amorphous resin, and wherein the hollow section has a volumetric capacity exceeding 10%.

(3) The hollow molded object described in claim 1, wherein the hollow molded object is made of a crystalline resin, and wherein the hollow section has a volumetric capacity exceeding 15%.

(4) A molding method for a hollow molded object, wherein the molding method has a step in which the hollow section forming fluid is injected into the cavity after the cavity

has been filled with a melted synthetic resin, forcing some of the melted synthetic resin inside the cavity into a spare chamber connected to the cavity and forming the hollow section.

(5) The molding method for a hollow molded object described in claim 4, wherein the space between the cavity and the spare chamber is blocked when the melted synthetic resin is injected into the cavity, and wherein the space between the cavity and the spare chamber is opened when the hollow space forming fluid is injected into the cavity.

(6) The molding method for a hollow molded object described in claim 4, wherein the interior of the cavity contains a groove extending inside the cavity from the vicinity of the melted synthetic resin injecting position to the vicinity of the spare chamber so as to form a reinforcing rib with a width exceeding 0.7 times the thickness of the mold.

3. Detailed Description of the Invention

[Industrial Field of Application]

The present invention relates to a hollow molded product and a molding method for a hollow molded product in which the hollow section is formed in the required position, the volumetric capacity of the hollow section is increased, and the surface of the molded product is superior.

[Prior Art]

In the prior art method, a hollow molded object is formed by injecting a melted synthetic resin into a cavity in an amount insufficient to fill the cavity and then injecting pressurized gas, or injecting both the melted synthetic resin and pressurized gas simultaneously (Japanese Examined Patent Application Disclosure No. 57-14968).

In this method, the injection of the pressurized gas expands the cavity and forms a hollow molded object with a thinner surface layer.

[Problem Solved by the Invention]

Unfortunately, the hollow molded objects and method for manufacturing hollow molded objects in the prior art experience the following problems.

(1) When a hollow molded object is formed by injecting a melted synthetic resin into a cavity in an amount insufficient to fill the cavity and then injecting pressurized gas, the surface of the hollow molded object tends to contain uneven ring-shaped bands (called "hesitation marks").

(2) When a hollow molded object is formed by injecting a melted synthetic resin into a cavity in an amount insufficient to fill the cavity and then injecting pressurized gas in an amount corresponding to the thermal contraction during the cooling and hardening of the melted synthetic resin, hesitation marks are not formed. However, the hollow section formed is only equivalent to the amount of thermal contraction. The volumetric capacity of a hollow section formed in this manner depends on the type of synthetic resin used (amorphous resin or crystalline resin, unreinforced or reinforced with a filler), the temperature conditions during the molding process, the thickness of the molded object,

and the shape of the molded object. However, the volumetric capacity is generally 3~10% in the case of an amorphous resin and 6~15% in the case of a crystalline resin. A hollow section with a volumetric capacity exceeding 15% cannot be obtained.

(3) Because the pressurized gas has difficulty expanding the melted synthetic resin farther away from the injection point of the pressurized gas, the thickness of the molded hollow section is thinner at the end. As a result, it is difficult to obtain a hollow section as designed.

(4) If the pressurized gas is injected with the melted synthetic resin, the gas has to be pressurized enough to resist the injection pressure of the melted synthetic resin, which usually exceeds 500 kg/cm^2. High-pressure injection places a great burden on production equipment, so is seldom practical.

(5) When a cavity is enlarged using pressurized gas, a relatively uniform hollow section with a large volumetric capacity can be formed. However, the surface of the hollow molded product is inevitably blemished.

[Means of Solving the Problem]

The present inventors discovered that hesitation marks are created when the injection of melted synthetic resin is suspended after switching from the injection of the melted synthetic resin to the injection of pressurized gas. In other words, melted synthetic resin begins to cool and harden as soon as it comes into contact with the inside of the cavity. When the injection of melted synthetic resin is suspended under these circumstances,

contact of the melted synthetic resin with the cavity wall is also suspended. This is the cause of hesitation marks.

When the cavity is expanded by the injection of pressurized gas, the expansion of the cavity causes the surface of the melted synthetic resin that has made contact with the cavity wall and already started to cool and harden to overstretch or overlap. This causes surface blemishes.

The present invention is the product of this discovery. The following is an explanation of the present invention with reference to FIG 1. In claim 1, the present invention is a hollow molded object, wherein the hollow molded object is formed by continuously injecting a melted synthetic resin 2 into a mold cavity 1, wherein the hollow molded object has a surface that is not overstretched or overlapping, and wherein the hollow molded object has a hollow section 3 with a volumetric capacity exceeding the amount of thermal contraction in the melted resin.

In claim 4, the present invention is a molding method for a hollow molded object, wherein the molding method has a step in which the hollow section forming fluid is injected into the cavity 1 after the cavity 1 has been filled with a melted synthetic resin 2, forcing some of the melted synthetic resin 2 inside the cavity 1 into a spare chamber connected 4 to the cavity and forming the hollow section 3.

The following is an explanation of the present invention.

In a hollow molded object of the present invention, the melted synthetic resin is continuously injected. As a result, the melted synthetic resin makes contact with the wall inside the cavity 1 at a constant rate without being cut off.

When a cavity 1 with an initial shape shown in FIG 2 (a) is expanded to the shape shown in FIG 2 (b), the melted synthetic resin 2 (the layer hardened in direct contact with the cool inner wall of the cavity 1) in section A of (a) is overstretched to resemble section A' in (b). In other words, the cavity 1 is expanded and the surface of the melted synthetic resin 2 in contact with the inner wall of the cavity 1 is overstretched. This is called overstretching for the purposes of the present invention. When a cavity 1 with an initial shape shown in FIG 3 (a) is expanded to the shape shown in FIG 3 (b), the melted synthetic resin 2 (the layer hardened in direct contact with the cool inner wall of the cavity 1) in section A of (a) is overlapped and resembles section A' in (b). In other words, the cavity 1 is expanded and the surface of the melted synthetic resin 2 in contact with the inner wall of the cavity 1 is overlapped. This is called overlapping for the purposes of the present invention.

The volumetric capacity of the hollow section 3 is the ratio of the volume of the hollow section 3 to the volume of the entire hollow molded object including the hollow section 3 for the purposes of the present invention.

A volumetric capacity exceeding the amount of thermal contraction in the synthetic resin is a volumetric capacity exceeding 10% in the case of an amorphous resin and a volumetric capacity exceeding 15% in the case of a crystalline resin.

The following is an explanation of the molding method of the present invention.

In the molding method of the present invention, as shown in FIG 1 (a), the injection nozzle 7 is brought into contact with the sprue 6 of a closed mold 5, a melted synthetic resin is injected, and the cavity 1 is filled with the melted synthetic resin.

The melted synthetic resin 2 used in the present invention can be any thermoplastic resin, thermoplastic elastomer or heat-cured resin ordinarily used in the injection molding process. Thermoplastic resins, thermoplastic elastomers or combinations of these are recommended. Additives, fillers, stabilizers, and reinforcing materials such as glass fibers commonly known in the art are also recommended.

The injection conditions for the melted synthetic resin 2 are similar to those for general injection molding. In the injection process for the melted synthetic resin 2, a single resin (foaming or non-foaming) can be injected or multiple resins can be used as in the sandwich molding process (these can be the same or different resins of both the foaming and non-foaming variety).

If a foaming resin is used, the interior of the cavity 1 is pressurized as commonly known in the art. The resin is then injected into the cavity under pressure so as to fill the cavity while not foaming.

After the cavity 1 has been filled with melted synthetic resin 2, as shown in FIG 1 (b), the hollow section forming fluid is injected into the cavity 1. When this is done, some of the melted synthetic resin 2 in the cavity 1 flows into the spare chambers 4 and a hollow section 3 is formed.

The injection of the hollow section forming fluid is performed from a fluid nozzle 8 built into the injection nozzle 7 as shown in FIG 1 (b). The hollow section forming fluid does not have to be performed from a fluid nozzle 7. It can also be injected directly into the cavity 1 via a different passage.

The high-pressure fluid used in the present invention can be nitrogen gas, carbon dioxide gas or air. Generally speaking, it should not be harmful or liquefy at molding temperatures and injection pressures. However, a fluid or oligomer that is incompatible with the molten synthetic resin can also be used.

The spare chambers 4 communicate with the cavity 1 so some of the melted synthetic resin inside the cavity 1 can flow into the chambers when the hollow section forming fluid is injected. The communication between the spare chambers 4 and the cavity 1 is such that the melted synthetic resin 2 fills the spare chambers 4 only after the melted synthetic resin 2 fills the cavity 1. This should be accomplished by making the flow resistance to the melted synthetic resin 2 greater in the connecting passages 9.

In order to make the flow resistance to the melted synthetic resin greater, the height of the connecting passages 9 should be 1 to 1/20th of the thickness of the cavity 1. Preferably, it should range between 1.5 and 10 mm, and ideally it should range between 3 and 5 mm. If the connecting passages have a round cross section, the diameter should be 1 to 1/20th of the thickness of the cavity 1. If the thickness and diameter of the connecting passage 9 are too great, the melted synthetic resin 2 does not flow initially only into the cavity 1. If the thickness and diameter of the connecting passage 9 are too small, the melted synthetic resin 2 does not flow into the spare chambers 4 easily when the hollow section forming fluid is injected.

Communication between the cavity 1 and the spare chambers 4 can be opened and closed. When the melted synthetic resin is injected into the cavity 1, for example, both passages can be blocked. When the hollow section forming fluid is injected into the cavity 1, both passages are opened. Here, the thickness of the connecting passages 9 can exceed the range described above.

The spare chambers 4 have a thickness greater than that of the connecting passages 9. The volume can be the rough equivalent of the hollow section 3 to be molded or can be the rough equivalent of the hollow section 3 to be molded minus the amount of thermal contraction in the melted synthetic resin 2. One or more spare chambers can be formed. In the case of the former, the total volume equals the volume of the hollow section 3 to be molded. The size of the spare chambers 4 is usually 2 to 20% of the total volume of the mold (i.e., the cavity 1 plus the spare chambers 4) when the thickness of the cavity 1 ranges between 1.5 and 8 mm, and 10 to 50% of the total volume of the mold when the thickness of the cavity 1 exceeds 8 mm.

The shape of the spare chambers 4 in cross section can be circular, semi-circular, triangular, square, rectangular, oval-shaped or any other shape. If the shape of the spare chambers 4 is round, they should still have the effect of causing the melted synthetic resin 2 to fill the chamber 1 before flowing into the spare chambers 4 when the hollow shape forming fluid is injected.

When the hollow section forming fluid is injected, the hollow section 3 is formed in the direction that the melted synthetic resin flowed into the cavity 1. The shape and position

of the hollow section 3 can be determined by where the spare chambers 4 connect to the cavity 1.

If, for example, a single spare chamber 4 is connected to the side of a cylindrical cavity 1 into which the melted synthetic resin 2 and the hollow section forming fluid are injected from the center, as shown in FIG 4 (a), a hollow section 4 (sic) can be formed eccentrically from the center towards the spare chamber 4. When the chamber 1 shown in FIG 4 (a) has three spare chambers 4 arranged around it at equal intervals as shown in FIG 4 (b), a hollow section 4 (sic) can be formed with three sides an equal distance from the center as shown in the drawing. When a groove 10 is formed at the desired position inside the cavity 1 to widen the space in the desired position inside the cavity 1 as shown in FIG 4 (c), a hollow section 3 can be formed along the groove 10. The groove 10 can extend from the injection position for the melted synthetic resin 2 towards the spare chambers 4 inside the cavity 1.

By using the method shown in FIG 4 (c), a molded object with a wide reinforcing rib can be formed. This is difficult to achieve using a method of the prior art.

If the groove 10 shown in FIG 4 (c) is used to form a reinforcing rib, the width of the reinforcing rib should exceed 0.7 times the thickness of the molded object. In this way, the thermal contraction on the underside of the reinforcing rib does not cause flaws when the reinforcing rib forms. This cannot be prevented using a molding method of the prior art. When the hollow section forming fluid flows along the groove 10, a hollow section 3 is formed inside the reinforcing rib.

The width of the reinforcing rib should be three times, and ideally four times, the thickness of the molded object. If wider, stronger reinforcement is not obtained but it requires more pressure to get the hollow section forming fluid to flow along the groove 10.

After the hollow section 4 (sic) has been formed, the pressure from the hollow section forming fluid is maintained as the melted synthetic resin 2 cools and hardens inside the cavity 1. The hollow section forming fluid is then discharged from the hollow section 4 (sic), the mold 5 is opened, and the hollow molded object is removed. When the hollow molded object is removed, the resin that flowed into and hardened in the spare chambers 4 is still attached as shown in FIG 1 (c). The excess resin is then cut off along the dotted lines shown in the same drawing.

Here, solid molded objects are formed in the cavity of the spare chambers 4. However, when the hollow section forming fluid is injected into the cavity for the hollow molded object and the spare chambers are filled with melted synthetic resin from the cavity 1, the hollow molded object formed in the main cavity is good. However, the spare chambers 4 in the present invention do not have to become completely filled. This has no effect on the hollow molded object.

[Operation]

The invention described in claim 1 prevents the hesitation marks from forming in the surface because melted synthetic resin is continuously injected into the cavity 1 and contact between the melted synthetic resin and the inner wall of the cavity 1 is not intermittent. Flaws also do not develop in the surface due to overstretching and

overlapping. A hollow molded object having a hollow section 3 with the volume capacity described in claim 2 and claim 3 is formed without any surface defects.

The invention described in claim 4 prevents the hesitation marks from forming in the surface because the cavity 1 is filled with melted synthetic resin 2 so the melted synthetic resin 2 makes continuous contact with the inner wall of the cavity 1. The injection of a hollow section forming fluid pushes some of the melted synthetic resin 2 into spare chambers 4. An amount of melted synthetic resin 2 equivalent to the hollow section 3 is removed from the cavity 1, the hollow section forming fluid is drawn into the cavity 1, and a hollow section 3 is formed.

In the invention described in claim 5, the passages between the cavity 1 and the spare chambers 4 are opened and closed. As a result, the melted synthetic resin fills the cavity 1 first even when the connecting passages 9 are thicker. The thicker connecting passages 9 allow for smoother flow of the melted synthetic resin into the spare chambers 4 when the hollow section forming fluid is injected.

In the invention described in claim 6, a groove 10 guides the hollow section forming fluid to form a hollow section inside a reinforcing rib.

[Working Examples]

Working Example 1

A hollow molded object was molded using a direct sprue mold 5 with a capacity of 3 cc connected to a spare chamber 4 via a connecting passage 9 on both sides of the cavity

1. The dimensions of the cavity 1 were width 5 cm, length 40 cm and thickness 0.4 cm. The dimensions of both spare chambers 4 were width 5 cm, length 5 cm and thickness 0.4 cm. The dimensions of the connecting passages 9 were width 3 cm, length 1 cm, thickness 0.4 cm.

The synthetic resin was rubber-reinforced polystyrene (Styron 494 manufactured by Asahi Chemical). The synthetic resin was injected under the following conditions to fill the cavity 1.

Injection Cylinder Temperature	220°C
Injection Pressure	500 kg/cm²G
Amount Used	90 cc
Injection Fill Time	4 seconds
Mold Temperature	50°C

After injection of the melted synthetic resin, nitrogen gas serving as the hollow section forming fluid was injected into the cavity 1 under the following conditions. When completed, the nitrogen gas was extracted, the mold 5 was opened, and the hollow molded object was removed.

Accumulator Tank (1 liter)	120 kg/cm²G
Equilibrium Pressure	109 kg/cm²G
Duration	90 seconds

The resin filled the spare chambers 4. Hesitation marks were formed in the surface of the resin hardened inside the spare chambers 4, but there were no flaws or hesitation marks on the molded object inside the cavity 1. The quality of the surface met the standards for molded products.

The molded object inside the cavity 1 was a hollow molded object, but the volumetric capacity of the hollow molded object was 23%.

Comparative Example 1

Molding was performed using the same device, resin and conditions in Working Example 1 except the connecting passages 9 in the mold 5 were closed, and the amount of resin used was 84 cc.

The molded object obtained in this manner had a surface free of hesitation marks, but there were flaws at the end of the flow. The hollow section 3 of the molded object was formed locally around the sprue 6, but the hollow section 3 was not formed at the end. The volumetric capacity of the hollow section 3 was approximately 4%.

The nitrogen gas injection period was extended from 90 seconds to 180 seconds, there were fewer flaws but the results were still unsatisfactory. When an hour elapsed before the molded object was removed, the number of flaws increased.

Working Example 2

A hollow molded object was molded using a direct sprue mold 5 connected to a spare chamber 4 via a connecting passage 9 on both sides of the cavity 1. The center of the cavity had a semi-circular groove 10 in the center with a length of 36 cm and a radius of 0.3 cm. The dimensions of the cavity 1 were width 5 cm, length 40 cm and thickness 0.3 cm. The dimensions of both spare chambers 4 were width 4 cm, length 0.9 cm and thickness 1 cm. The dimensions of the connecting passages 9 were width 3 cm, length 0.7 cm, thickness 0.25 cm.

The synthetic resin was a copolymer polypropylene (M8619 MI14 manufactured by Asahi Chemical). The synthetic resin was injected under the following conditions to fill the cavity 1.

Injection Cylinder Temperature	220°C
Injection Pressure	600 kg/cm^{2}G
Amount Used	70 cc
Injection Fill Time	3 seconds
Mold Temperature	40°C

After injection of the melted synthetic resin, nitrogen gas serving as the hollow section forming fluid was injected into the cavity 1 under the following conditions. When completed, the nitrogen gas was extracted, the mold 5 was opened, and the hollow molded object was removed.

Accumulator Tank (1 liter)	140 kg/cm^{2}G
Equilibrium Pressure	132 kg/cm^{2}G
Duration	40 seconds

The resin filled the spare chambers 4. Hesitation marks were formed in the surface of the resin hardened inside the spare chambers 4, but there were no flaws or hesitation marks on the molded object inside the cavity 1. The quality of the surface met the standards for molded products.

The molded object inside the cavity 1 was a hollow molded object that was hollow from the center of the rib with a 0.3 cm radius in cross section to the end. The volumetric capacity of the hollow section 3 in the hollow molded object was 19%.

Comparative Example 2

Molding was performed using the same device, resin and conditions in Working Example 2 except the connecting passages 9 in the mold 5 were closed.

The molded object obtained in this manner had a surface free of hesitation marks, but there were flaws on the back of the rib at the end of the flow. The volumetric capacity of the hollow section 3 was 7%. The hollow section 3 of the molded object extended 13 cm from the sprue 6 in the center along the rib, which is semicircular in cross section. The hollow section 3 was not formed in the portion 13~20 cm from the center (at the end of the flow).

When the nitrogen gas injection time was extended to 80 seconds, the hollow section 3 of the molded object extended 15 cm from the sprue 6 in the center, and there were very few flaws at the end of the flow. However, the shape of the hollow section 3 took the shape of the reinforcing rib and was angular as shown in FIG 6.

Working Example 3

A hollow molded object was molded using a direct sprue mold 5 connected to a spare chamber 4 (width 10 cm, thickness 1 cm) via a connecting passage 9 (width 5 cm, length 0.7 cm, thickness 0.25 cm) on both sides of the cavity 1 (width 20 cm, length 50 cm). The center of the cavity had a groove 10 with an equal width and height in the center. The height of the cavity 1 and the width (height) of the groove 10 changed. The length of the spare chambers 4 also changed in the same manner.

The synthetic resin was a PPE/PA "alloy" (X9601 manufactured by Asahi Chemical). The synthetic resin was injected under the following conditions to fill the cavity 1.

Injection Cylinder Temperature	280°C
Injection Pressure	1800 kg/cm^2G
Injection Fill Time	10 seconds
Mold Temperature	60°C

The relationship between the required injection pressure and the thickness (t) of a molded object the width (W) of the groove 10 is shown in FIG 7.

The ratio of the thickness (t) of the molded object to the width (W) of the reinforcing rib should be three or more and ideally four or more in order to significantly reduce the required injection pressure. A hollow section was formed by the reinforcing rib all the way to the end because of the connecting passages 9 and spare chambers 4 on both ends.

[Effect of the Invention]

As explained above, the present invention has the following effects.

(1) Because a molded object with a good surface can be obtained using the inventions described in claim 1 and claim 4, the amount of time required to finish the object can be reduced, and molded objects with a good external appearance can be obtained easily.

(2) A molded object with a large hollow section 3 and a good surface can be obtained using the inventions described in claim 2 and claim 3.

(3) A hollow section 3 can be obtained corresponding to the amount of melted synthetic resin by injecting a hollow section forming fluid according to the invention described in

claim 4. The hollow section 3 also has a uniform thickness. As a result, a hollow section 3 can be obtained as designed.

(4) The switching time from the injection of the melted synthetic resin to the injection of the hollow section forming fluid can be easily controlled using the invention described in claim 5.

(5) Effective reinforcement is provided by the wide reinforcing ribs in the invention described in claim 6. This reduces the amount of flaws in the external surface of the molded object. Also, the hollow section 3 is not formed where it is not required and the hollow section 3 is formed where it is required. As a result, the structural strength of the molded object is not undermined by the excessive formation of the hollow section 3.

4. Brief Explanation of the Drawings

FIG 1 (a) through FIG 1 (c) are drawings used to explain the molding method for the molded object of the present invention. FIG 2 (a) and FIG 2 (b) are drawings used to explain overstretching of the surface. FIG 3 (a) and FIG 3 (b) are drawings used to explain overlapping of the surface. FIG 4 (a) through FIG 4 (c) are drawings used to explain the shape and positioning of the hollow section. FIG 5 is a perspective view of the molded object in the second working example. FIG 6 is a cross-sectional view of the molded object in the second comparative example. FIG 7 is a graph showing the results from the third working example.

1: cavity

2: molten synthetic resin

3: hollow object

4: spare chamber

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FIG 1

FIG 2

FIG 3

FIG 4

FIG 5

FIG 6

FIG 7

[x-axis] w/t ratio

[y-axis] extrusion pressure (kg/cm^2G)

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1. Application

Patent Application No. 1-258690

2. Title of the Invention

Hollow Molded Object and Molding Method Therefor

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5. Sections to be Amended

Claims and Detailed Description of the Invention in the Specification

6. Content of the Amendment

(1) The claims are amended as shown on the next page.

(2) Page 6, Line 5 of the Specification

Here, "exceed" (misspelled) has been amended to read exceed.

(3) Page 6, Lines 9-16 of the Specification

"In claim 4, the present invention ... forming the hollow section 3." has been amended to read "In claim 4, the present invention is a molding method for a hollow molded object, wherein the molding method has a step in which the hollow section forming fluid is injected into the cavity 1 after the cavity 1 has been filled with a melted synthetic resin 2, forcing some of the melted synthetic resin 2 inside the cavity 1 into a spare chamber 4 connected to the cavity 1 and forming the hollow section 3, and wherein the volume of the spare chamber 4 is equivalent to the volume of the hollow section 3, and the thickness or diameter of the connecting passage 9 to the spare chamber 4 is 1 to 1/20th the thickness of the cavity 1 so the flow resistance to the melted synthetic resin 2 is greater than inside the cavity 1.

(4) Page 9, Lines 1, 2 and 3 of the Specification

Here, "exceed" (misspelled) has been amended to read exceed.

(5) Page 10, Lines 10-12 of the Specification

Here, "such that the melted synthetic resin 2 ... in the connecting passages 9." has been amended to read "such that the flow resistance to the melted synthetic resin 2 is greater in the connecting passages 9 than inside the cavity 1."

(6) Page 10, Line 15 of the Specification

Here, " should be 1 to 1/20th of the thickness" is amended to read "has to be 1 to 1/20th of the thickness".

(7) Page 10, Line 19 of the Specification

Here, "it should range" is amended to read "it ranges".

(8) Page 11, Lines 10-12 of the Specification

"Here, the thickness ... described above." has been omitted.

(9) Page 16, Line 5 of the Specification

The following sentence is inserted between the second and third sentences: "The thickness or diameter of the connecting passage 9 is 1 to 1/20th the thickness of the cavity 1 so the flow resistance to the melted synthetic resin 2 is greater than the cavity 1 and the cavity 1 is filled with melted synthetic resin 2 before the melted synthetic resin 2 enters the spare chamber 4."

(10) Page 16, Line 10 of the Specification

The following sentence is added to the end of the paragraph: "The volume of the spare chamber 4 is equivalent to the volume of the hollow section 3 so as to control the volume of the hollow section 3."

(11) Page 16, Lines 12-17 of the Specification

"The thicker connecting passages 9 ... is injected." has been amended to read "This is better at preventing the flow of melted synthetic resin 2 into the spare chamber 4 before the cavity 1 has been filled with the melted synthetic resin 2."

Claims

(1) A hollow molded object, wherein the hollow molded object is formed by continuously injecting a melted synthetic resin into a mold cavity, wherein the hollow molded object has a surface that is not overstretched or overlapping, and wherein the hollow molded object has a hollow section with a volumetric capacity exceeding the amount of thermal contraction in the melted resin.

(2) The hollow molded object described in claim 1, wherein the hollow molded object is made of an amorphous resin, and wherein the hollow section has a volumetric capacity exceeding 10%.

(3) The hollow molded object described in claim 1, wherein the hollow molded object is made of a crystalline resin, and wherein the hollow section has a volumetric capacity exceeding 15%.

(4) A molding method for a hollow molded object, wherein the molding method has a step in which the hollow section forming fluid is injected into the cavity after the cavity has been filled with a melted synthetic resin, forcing some of the melted synthetic resin inside the cavity into a spare chamber connected to the cavity and forming the hollow section, and wherein the volume of the spare chamber is equivalent to the volume of the hollow section, and the thickness or diameter of the connecting passage to the spare chamber is 1 to 1/20th the thickness of the cavity so the flow resistance to the melted synthetic resin is greater than inside the cavity.

(5) The molding method for a hollow molded object described in claim 4, wherein the connecting passage can be opened and closed, and wherein the connecting passage is blocked when the melted synthetic resin is injected into the cavity, and the connecting passage is opened when the hollow space forming fluid is injected into the cavity.

(6) The molding method for a hollow molded object described in claim 4 or claim 5, wherein the cavity has a groove extending inside the cavity from the vicinity of the melted synthetic resin injecting position to the vicinity of the spare chamber so as to form a reinforcing rib with a width exceeding 0.7 times the thickness of the mold